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# (54) Log diameter measurement

(57) The diameter of elongate objects 4, e.g. logs 7, on a moving conveyor 25 is measured by transverse emitter 11 and receiver 12 arrays. The cross-section of the conveyor guideway 27, on which the objects 4 are transported by carriers 34, is reduced 37 to accommodate some of the measuring beams. Alternatively, the guideway may be offset (fig. 5) or a complete guideway gap may be provided (fig. 10), bridged by a shuttling part 81.

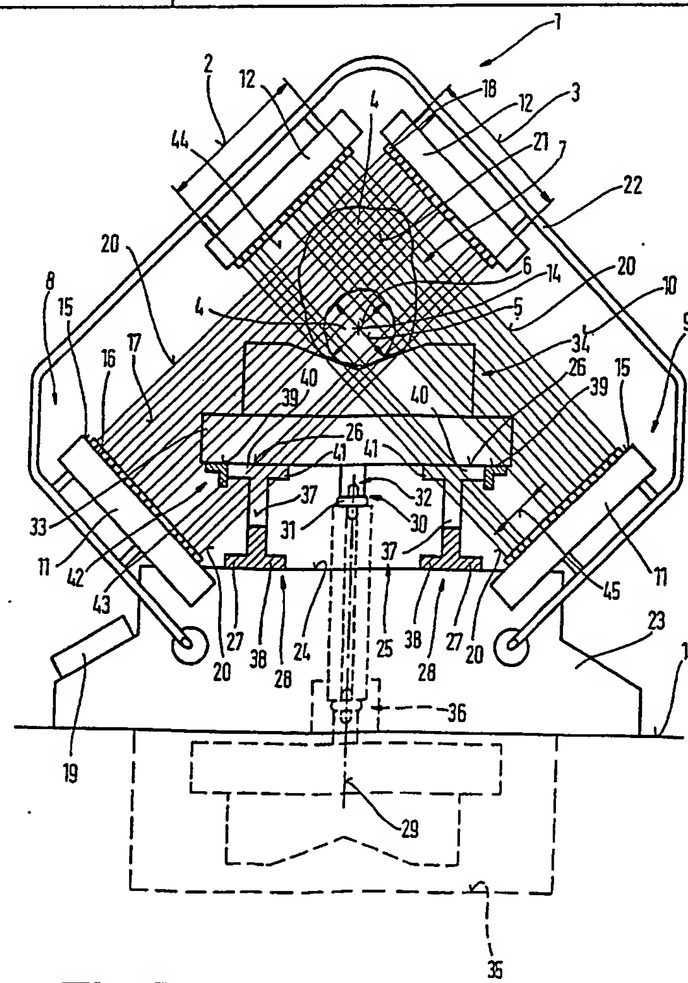

Fig.1

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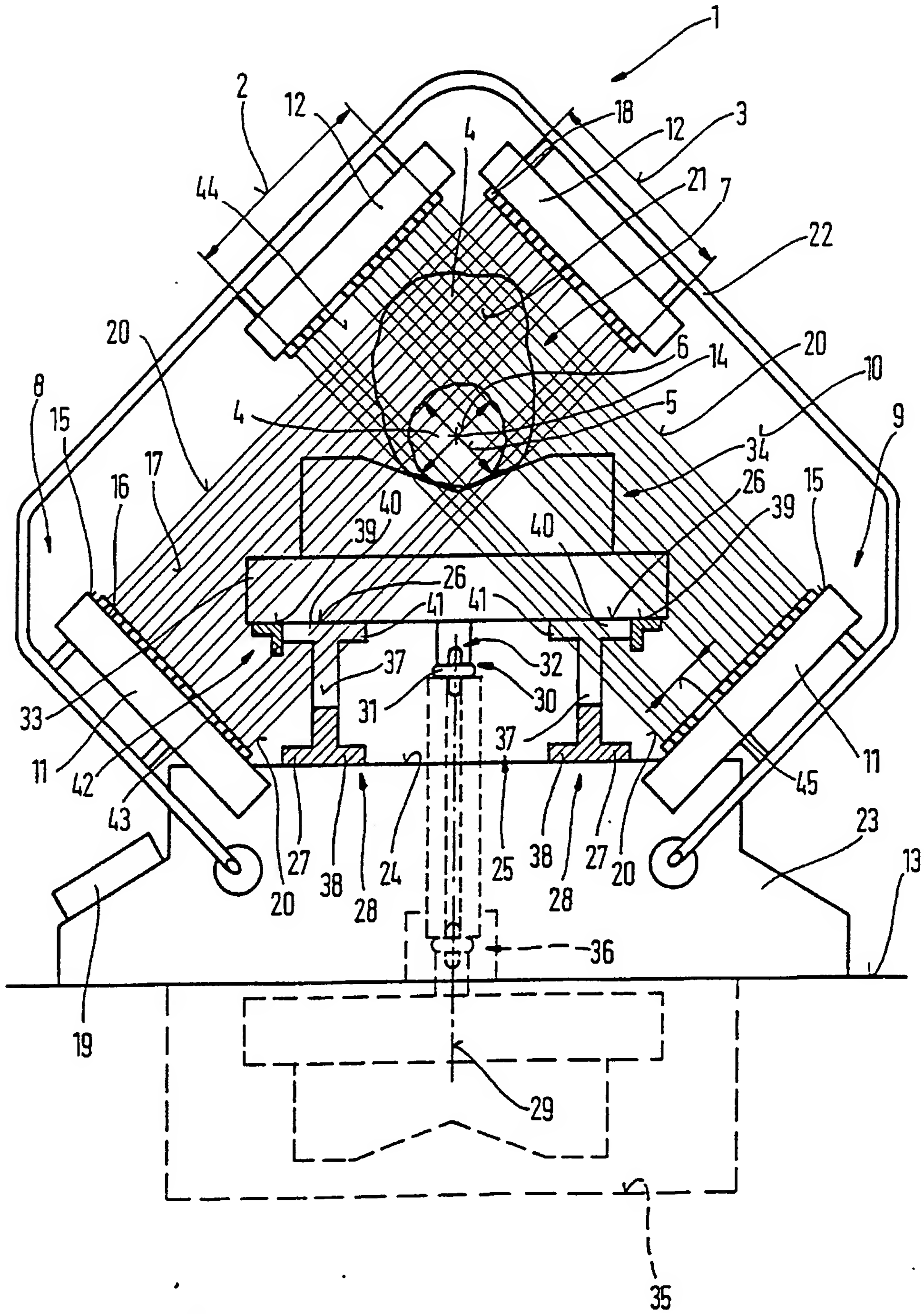
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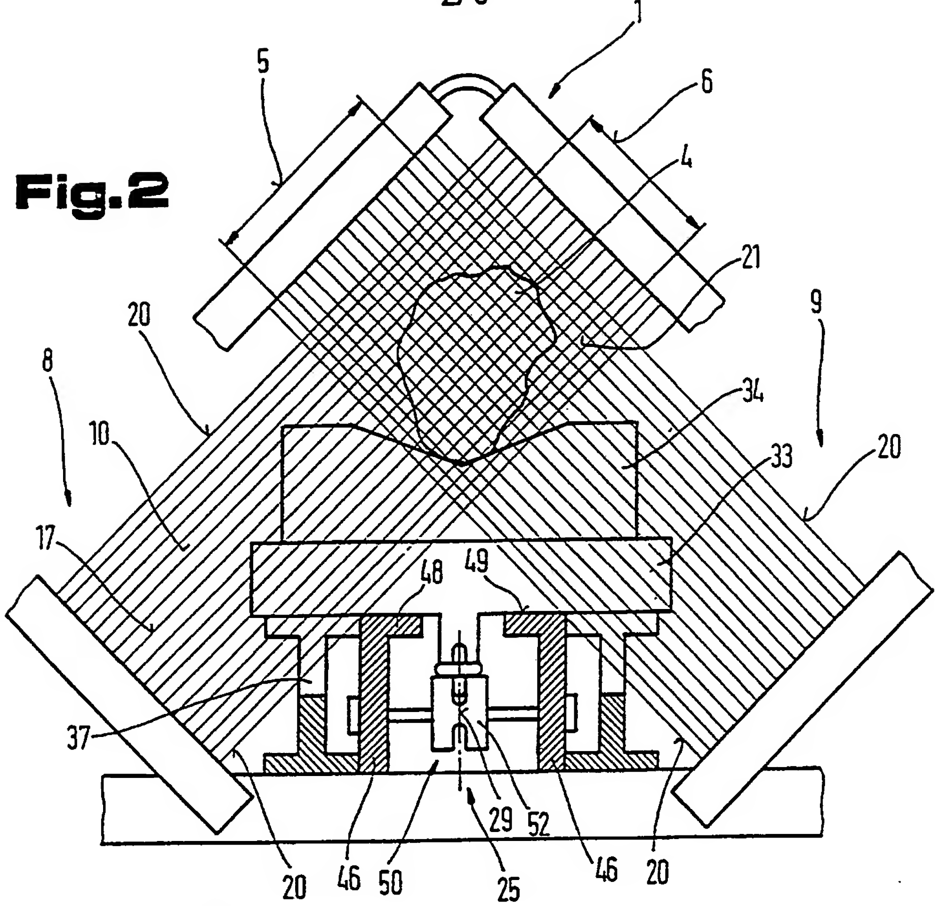
Fig.1


1
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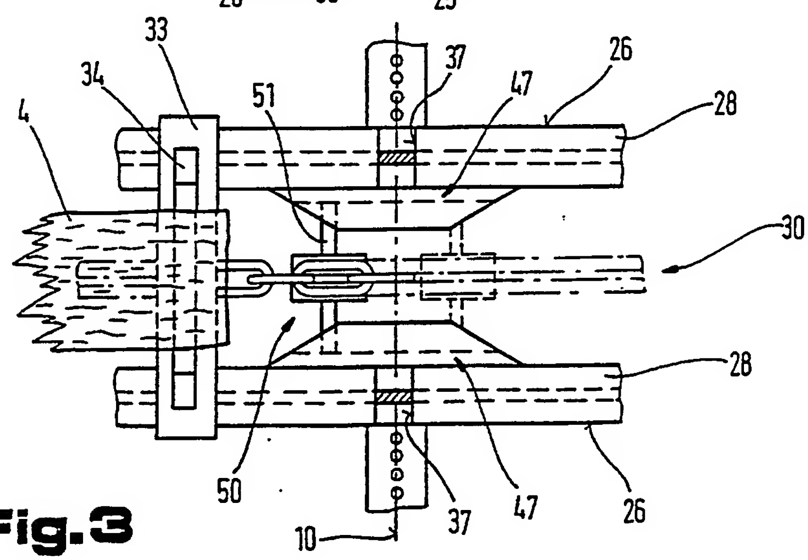
20

Fig.2


33
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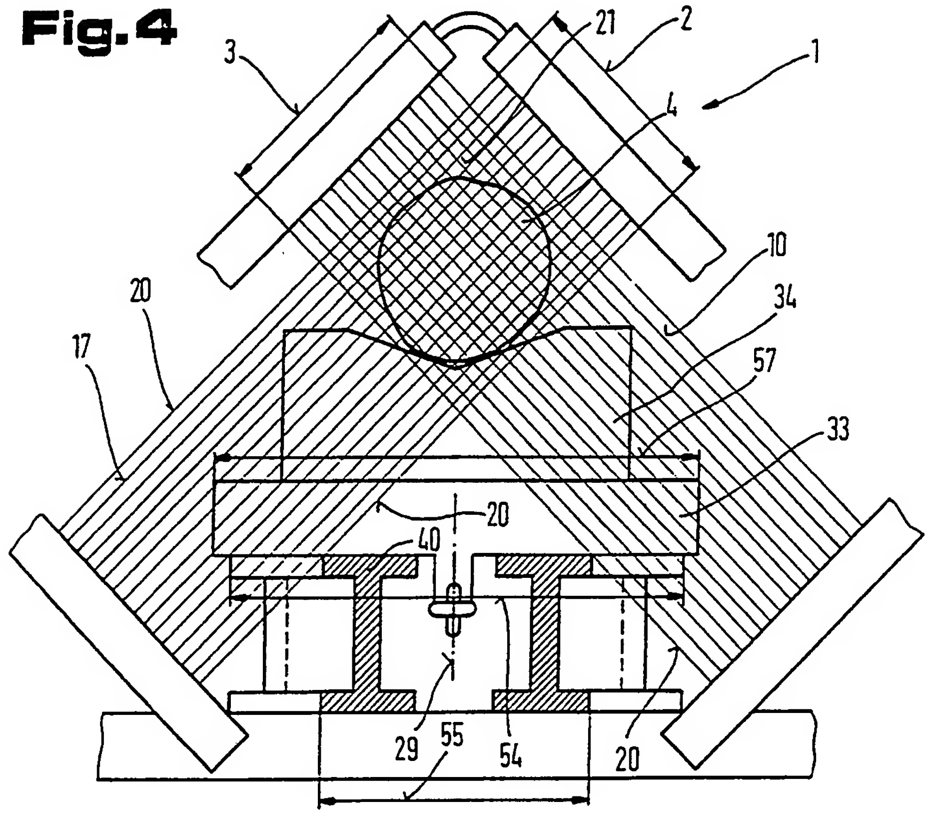
10

Fig.3

Fig. 4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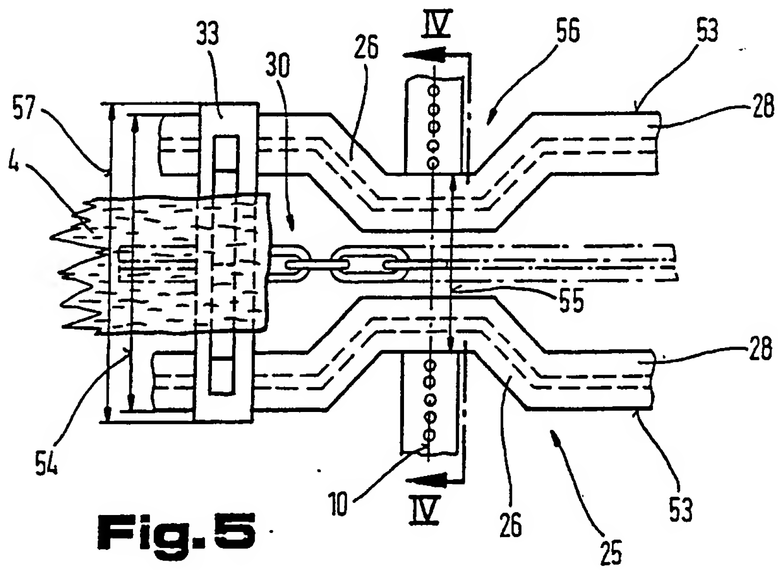
IV
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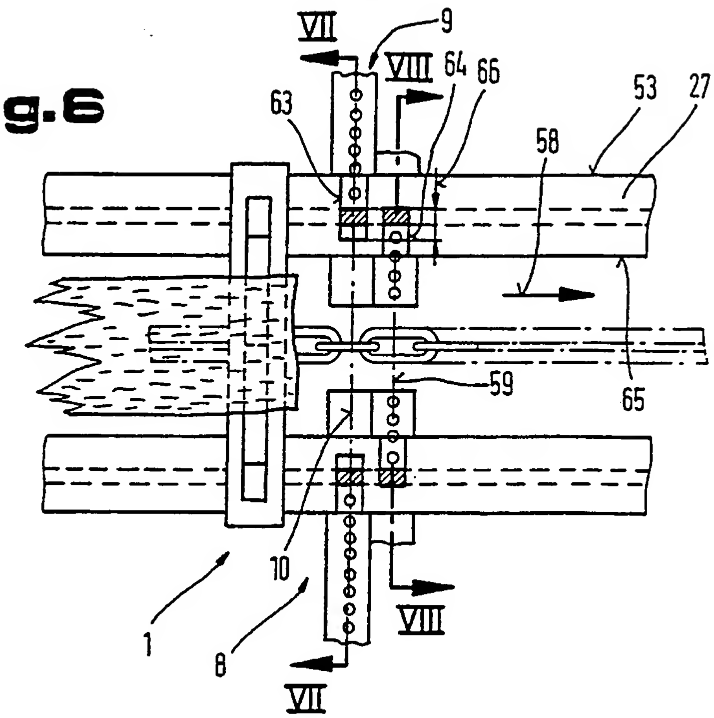
57

Fig. 5

Fig.6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VIII
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53
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58
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65
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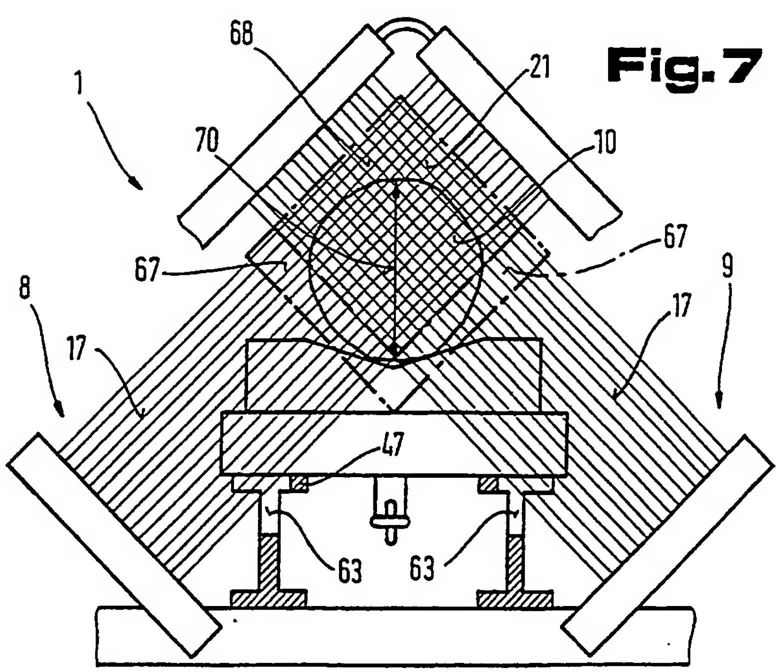
8
VIII
VII


68
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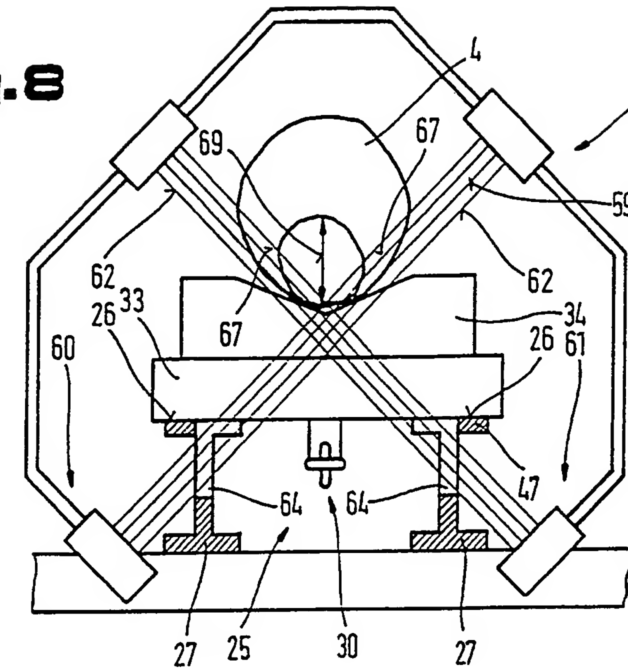
63
63

Fig.7

Fig.8


4
1
69
67
59
62
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61
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25
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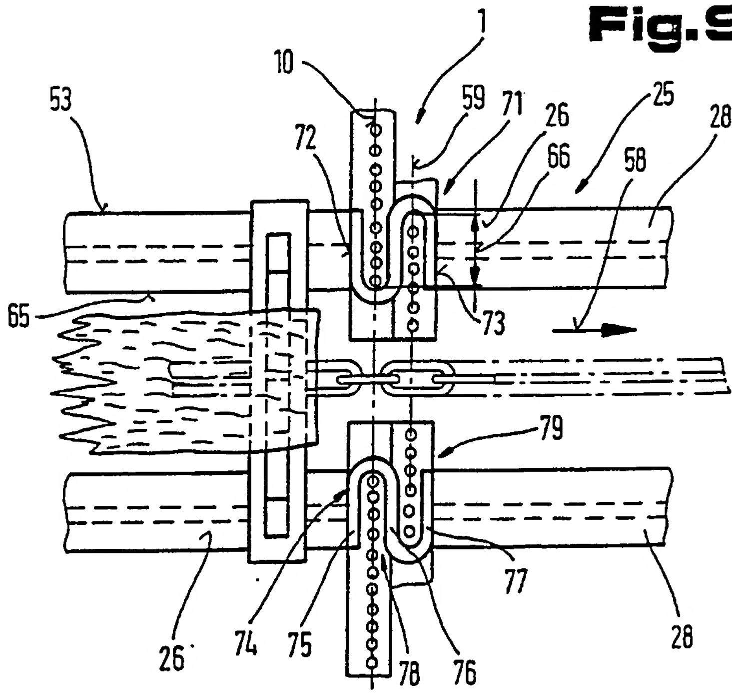
27

Fig.9


1
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59
71
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**Fig.10**

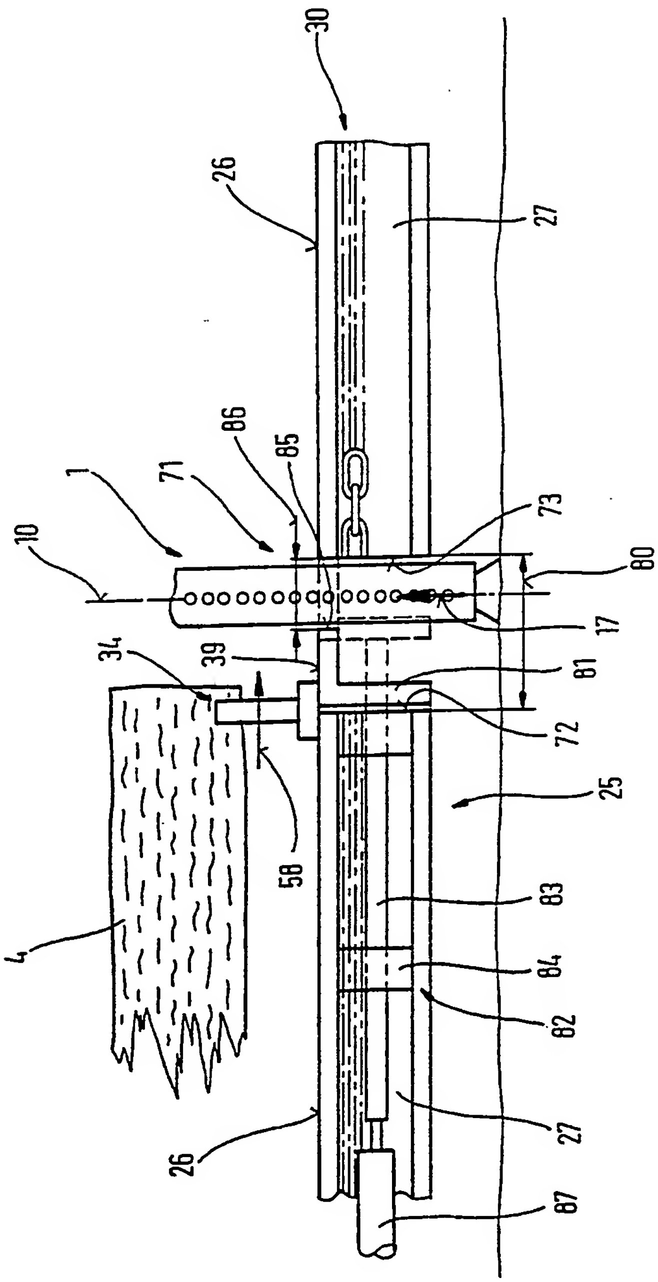

Fig.11

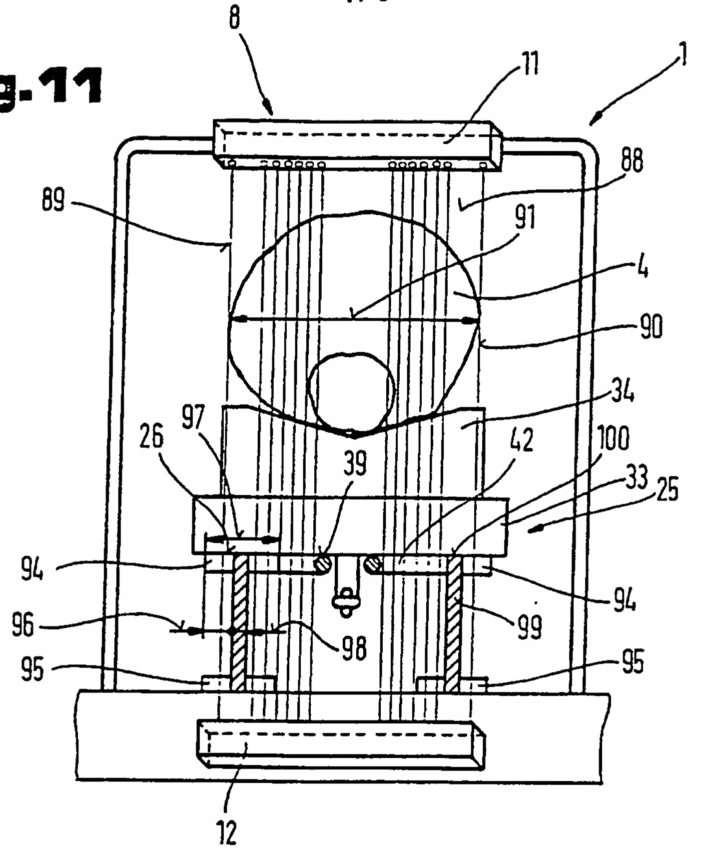
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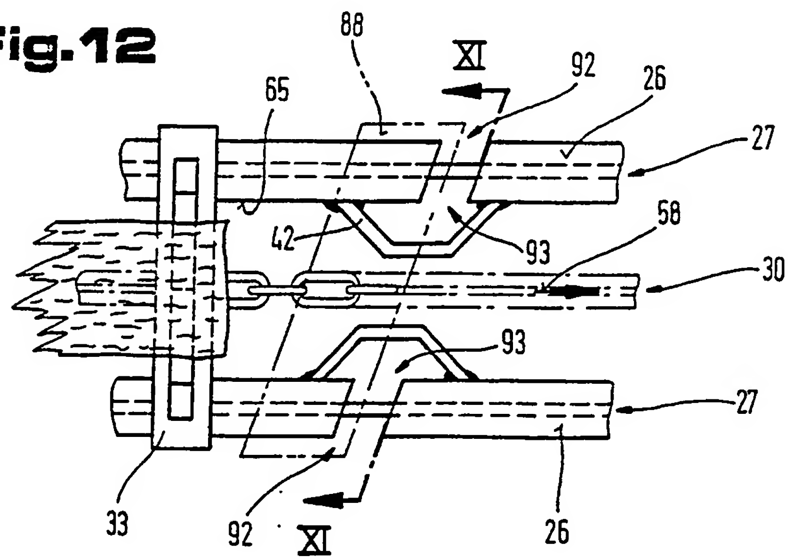
Fig.12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XI
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65
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58
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93
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93
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33
92
XI
26

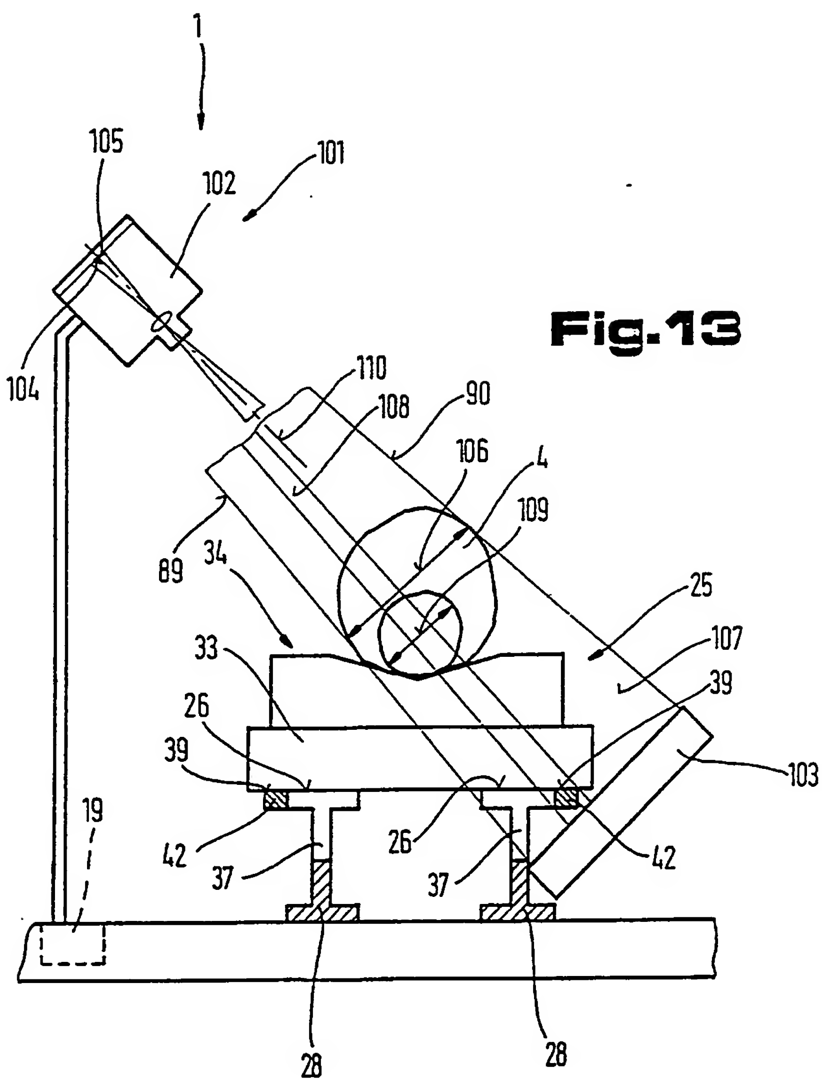
1
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Fig.13

# APPARATUS FOR MEASURING ELONGATE OBJECTS

This invention relates to apparatus for measuring elongate objects, such as logs of the type wherein a measuring plane of light beams is formed by at least one transmitter and receiver arrangement, the measuring plane extending across the path of an elongate object through a conveyor system.

Known equipment used to establish and/or monitor the diameter of a log (examined German application DE-B-25 55 975) comprises diameter-measuring equipment for round timber which, for the purpose of determining diameter, has a plurality of radiation-sensitive units positioned on a measuring surface facing which is a radiation source designed to produce a silhouette of the object on the measuring surface. However, measuring equipment of this kind requires conveyors positioned separately on each side of the measurement plane for the purpose of continuously measuring a log conveyed longitudinally along it. With this known measuring equipment, the log shifts position when being transferred from one conveyor to another and this increases dimensional inaccuracies.

With other known measuring equipment (unexamined German application DE-A-34 14 819) the measuring beams emitted by the measurement emitter to the measurement

receiver run horizontally, and the log to be measured is in an elevated position on conveyor supports so that the log contour facing the conveyor is above it and can be scanned. However, this measuring arrangement makes it possible to measure only one diameter value in one pass and is not therefore susceptible of verification.

With another known device (unexamined Swedish application 73 832), the diameter of the logs is calculated from two measurement results obtained consecutively with emitter and receiver arrangements positioned at right angles to each other in one measurement plane. This device has a continuous conveyor arrangement with the guideways separated in the area of the measurement plane to allow the beams to pass through without obstruction. This makes the conveyor system very unstable, however, which in turn causes a greater number of disruptions and greater wear and tear, and the measurement result is inaccurate as a result of shifts in the object's position in the area of the break in the guideway. Some improvement was achieved in this case by staggering the breaks in the parallel guideways in relation to the direction of travel. All in all, however, the level of accuracy achieved is not satisfactory with this design either.

The present invention consists in apparatus for measuring elongate objects passing along a conveyor system including a substantially horizontal guideway having one or

more support surfaces for carriers supporting the objects to be measured, said apparatus comprising at least one measuring assembly with an emitter and receiver positioned on opposite sides of the conveyor to transmit and receive beams of radiation in a measuring plane extending across the path of said objects on the conveyor, wherein said guideway has at least one section, with a support surface thereon, which, if extended past said emitter and receiver, would intersect the paths of at least some of the beams passing therebetween, and wherein in the region of said measurement plane said guideway section is replaced by a section which is offset relative thereto and/or of smaller cross-section dimension, or by a support moveable longitudinally across a gap in the guideway section, so as to interrupt fewer of said beams.

By means of the invention there can be provided a device which makes it possible for the diameter to be determined without disruption over the entire range of diameters to be measured, and with which measurement errors owing to changes in the object's position are avoided.

The surprising advantage of this solution is the fact that the guideways in the area of the measurement plane form a continuous support for the conveyor system carriers, and the design of the guideways in the measuring area does not disrupt measuring in the object areas used to determine diameter. By offsetting the guideway parts it is

now possible to position these outside the measuring area or, as a result of the smaller cross-sectional dimension of the guideway part in the measurement plane, it is now possible to omit these areas from the measurement process without an appreciable deterioration in accuracy or, if a second silhouette edge is missing in the area of the interrupted measuring beams, it is now possible to take the measurement again with the object in a different position.

In a preferred embodiment the said guideway part in the measurement plane is positioned and dimensioned so as to allow beams passing on both sides of it to encounter the smallest object to be measured, or so as to lie outside the beam width needed to measure the largest such object. In this way, where the guideway parts in the area of the measurement plane cannot have a subsequent effect on measuring accuracy since any overlap between the silhouettes of guideway parts and silhouette edges of the object to be measured is completely ruled out.

According to an advantageous further development the measuring plane is arranged diagonally to the direction of travel and the guideway is correspondingly offset whereby the silhouette produced in the measurement plane by the interruption in the measuring beams caused by the guideway parts is outside the measuring area of the object to be measured.

In one preferred embodiment the width of the guide

surface narrows as it passes the measuring plane, so that the guideway-facing lower peripheral area of the object to be measured is thereby positioned outside the interrupt area of the measuring beams even if there are severe bends in a longitudinal direction.

The guideway is preferably also offset inwardly so that it is clear of the beams but nonetheless extends through the measurement plane without a break so that an uninterrupted support is provided for the carriers of the object to be measured and the guideway-facing bottom of the object is freed so that the diameter can be scanned without obstruction.

In accordance with another advantageous embodiment two measurement planes are provided, which are adjacent in the direction of travel, each associated with respective recesses or offsets of guideway parts, which are positioned in different, preferably overlapping, areas in relation to a cross-sectional area of the object so that every part of the periphery of the object passed through uninterrupted beams of at least one of the measuring planes whereby an overlap of the measuring areas is achieved and values outside a measuring area owing to bends, for example, are picked up in adjacent areas.

The conveyor system preferably includes a conveying element such as a chain, with the carriers firmly joined to it. Supports for the conveyor element are preferably

provided immediately adjacent guideway breaks.

Preferably the conveying element continuously spans the region of the measurement plane, whereby the measuring equipment can also be used in retrofitting existing conveyor devices for the purpose of automating said systems.

To provide a secure support for the carriers even when their load is uneven as a result of bent logs, the conveyor preferably has a pair of laterally spaced guide surfaces bridged by guide plates which are movably connected to the conveying element and support the carriers.

In another preferred embodiment, measuring beams of one measurement plane which are interrupted by sections of a guideway part pass through another parallel measurement plane, incongruently in the direction of travel, whereby a measurement that cannot be taken in a measurement plane in the interrupt area is, at all events, taken in the measurement plane parallel thereto.

The carrier or carrier guide-plate is preferably supported at right angles to the guideway during movement from one front end to another front end of the discontinuous guideways, thereby avoiding shifts in position which affect the measurement results in this area.

In a preferred embodiment the object to be measured has its minimum dimension positioned in an area of overlap

in the measuring beams where parallel measurement planes are interrupted in the direction of travel.

In a preferred embodiment the guideway part is movably supported in the longitudinal direction of the guideway and is fitted with a drive or a stop which interacts with the carrier and wherein one adjustment path of the guideway part corresponds to at least one width between the spaced front ends of the guideway in the area of the measurement plane. Thus, in the parts of the measuring area with a slight shadow caused by the guideway parts, diameter can be established by interpolation or approximation, with the result that the level of inaccuracy of the system is less than the magnitude of the width of the guideway-part silhouette.

In another advantageous embodiment by means of a control device forming part of the measuring equipment, in the absence of one of the control signals defining one of the two edges of the silhouette of the object being measured, at least one emitter and receiver arrangement adjacent to the emitter and receiver arrangements of the measuring beams interrupted by guideway parts is simultaneously connected to one or more of the emitter and receiver arrangements facing the interrupted measuring beams. It is thus possible readily to establish whether the edge of the silhouette of the object to be measured is positioned in the measurement-plane area formed by the

measuring beams interrupted by the guideway part. Preferably, the receiver units immediately adjacent, on both sides of the receiver units for the interrupted measuring beams are consecutively actuated via the control and evaluation unit, consecutively in each case with half the beam receivers for the interrupted measuring beams and wherein an output signal from the relevant beam receivers is evaluated and/or stored in the control and evaluation unit. In this way it is possible immediately to detect faulty measurements caused by the silhouettes of the guideway parts.

Preferred embodiments of the invention will now be described in further detail with reference to the accompanying drawings wherein:

Figure 1 is a front view of measuring equipment according to a first embodiment of the invention, partly in section and in simplified form;

Figure 2 is a front view of another embodiment of the measuring equipment, again partly in section and in simplified form;

Figure 3 is a partial top plan view of the measuring equipment shown in Fig. 2;

Figure 4 shows another embodiment of the measuring equipment, in front view, partly in section through lines IV-IV in Fig. 5;

Figure 5 shows the measuring equipment of Fig. 4, in plan

view;

Figure 6 is a plan view of another embodiment of the measuring equipment with two measurement planes;

Figure 7 shows the measuring equipment of Fig. 6, in cross-section through lines VII-VII in Fig. 6;

Figure 8 shows the measuring equipment of Fig. 6, in cross-section through lines VIII-VIII in Fig. 6;

Figure 9 is a partial top plan view of another embodiment of the measuring equipment with two measurement planes;

Figure 10 is a side view of a further development of the measuring equipment according to the invention, with a co-moving guideway part, side view;

Figure 11 shows another embodiment of the measuring equipment with a diagonal measurement plane, in section through lines XI-XI in Fig. 12;

Figure 12 is a partial top plan view of the measuring equipment shown in Fig. 11; and

Figure 13 is a front view, partly in section, of a further development of measuring equipment according to the invention.

Fig. 1 shows measuring equipment 1 used to establish and monitor dimensions 2,3 of an object 4. As illustrated, the dimensions 2,3 are diameters 5,6, approximately at right angles to each other, of a log 7 forming the object 4. The measuring equipment 1 comprises two electro-optical

emitter and receiver arrangements 8,9, which form a measurement plane 10 positioned approximately at right angles to the direction of travel of the object 4. Each of the emitter and receiver arrangements 8 and 9 comprises a beam emitter 11 and a beam receiver 12, positioned parallel to each other, at an angle of approximately 45° to a support surface 13 and approximately symmetrical about a longitudinal centre line 14 of the object 4. On their surfaces 15 facing the object 4 and spaced slightly apart, the beam emitters 11 have light-emitting diodes or other sources 16 for measuring beams 17 which are picked up by receiver units 18 located in the beam receiver 12 positioned opposite and converted into signals which are transmitted to a control and evaluation unit 19.

Boundary beams 20 define the limits of a cross-sectional measurement area 21 for the maximum dimensions 2,3 of the object 4. The emitter and receiver arrangements 8,9 are positioned relative to each other by means of a supporting frame 22 which is, for example, anchored in a bed 23 or secured thereon.

Positioned on a surface 24 of the bed 23 facing the cross-sectional measurement area 21 is a conveyor device 25 for the object 4. The conveyor device 25 is made up of profile sections 27, for example I beams 28, which form parallel guideways 26. Positioned between these profile sections, approximately in the region of an axis of

symmetry 29, is a continuous conveying element 30, comprising a round link chain 31 or a belt or a flat chain. Guide plates 33 of a carrier 34 supported on the guideways 26 of the I beams 28 are movably connected to a conveying run 32 of the conveying element 30. The conveying element 30 with the guide plates 33 and carriers 34 are often used as a return run 36 in the opposite direction to the direction of travel and located for this purpose in a shaft-like recess 35, for example underground, as shown in broken lines.

In the region of the measurement plane 10 the profile sections 27 have slot-like recesses 37 extending from the guideway 26 in the direction of a bottom chord 38, to allow the measuring beams 17 from the beam emitter 11 to pass to the beam receiver 12 without a shadow being cast, in order to form the cross-sectional measurement area 21 bordered by the boundary beams 20. To produce a support surface 39 in the area of the slot-like recesses 37 for the guide plate 33, guideway parts 42 formed, for example, by angle members 43, tubing, web plates or profile sections, are located on the chord 41 of the I beam 28 forming a carrying run 40, on the side remote from the axis of symmetry 29.

Designing the guideway parts 42 as angle members 43 produces a corresponding bend strength in the area of the slot-like recesses 37 to absorb the bearing loads of the carriers 34 exerted via the guide plate 33. In addition,

locating the corner pieces 43 on the I beams 28 in a position away from the axis of symmetry 29 produces an interrupt area 44 for the measuring beams 17 inside a minimum dimension 45 of the object 4, thereby making it possible for the diameters 5,6 to be measured without obstruction in the area inside the minimum dimension 45 and the maximum dimensions 2,3 determined by the boundary beams 20.

It is possible to retrofit an existing conveyor system with the measuring equipment 1 without a great deal of installation work. To this end, recesses 37 are made in the I beams 28, and the corner pieces 43 are put into position, for example by being welded onto the chord 41, to form the support area 39. It is also very easy to adapt the carrier 34 or the guide plate 33 to the extra width of the conveyor device 25 by welding end pieces onto both sides, as shown by the double broken line.

Figs. 2 and 3 show the measuring equipment 1 with the emitter and receiver arrangements 8,9 and the conveyor device 25 for the object to be measured 4. The same reference symbols are used for the same parts in this case. The conveyor device 25 has essentially the I beams 28 forming the guideways 26 and the conveying element 30 positioned between them. Supported on the guideways 26 are the carriers 34 with the guide plates 33, movably joined to the conveying element 30 and movable by it in the direction

of travel. The conveyor device 25 has carriers 34 at equal intervals over its entire length, the maximum distance between two consecutive carriers 34 being smaller than the minimum length of the object to be measured 4. This ensures that the object 4 is supported at least on two consecutive carriers while being conveyed. The carriers are often also positioned closer together so as to provide better support, in particular for objects 4 which are bent lengthwise.

To ensure that the conveyor device 25 passes through the measurement plane 10 without interrupting the measuring beams, the I beams 28 have the slot-like recesses 37 which interrupt the guideway parts 26 in the area of the measurement plane 10 so as to allow the measuring beams 17 to pass through freely. Positioned towards the axis of symmetry 29 or the conveying element 30 in the area of the measurement plane 10 are guideway parts 47 formed, for example from an L section 46, with a chord 48 projecting towards the conveying element 30 forming a guide surface 49 for the guide plate 33 of the carrier 34 in the area of the slot-like recess 37. This means that the carrier 34 can move without jerking or tipping even in the area of the slot-like recesses 37, as a result of which the object to be measured 4 does not shift position in the measurement plane 10.

Offsetting the guideway parts 47 in the direction of

the axis of symmetry 29 produces a shadow-free cross-sectional measurement area 21 inside the boundary beams 20, as a result of which the whole of the peripheral area with both a minimum and a maximum dimension can be scanned by the measuring beams 17, and hence the diameters 5,6 of the object 4 can be established.

It is also possible to position one or more supports 50 in the region of the measurement plane 10 or immediately before or after it in the direction of travel to provide positional stability for the conveying element 30. These supports 50 may be formed, for example by rolls, for example chain wheels 52, guide rolls or contact rolls, pivoted on a hinge pin 51 positioned horizontally and running approximately at right angles to the direction of travel. This ensures that the conveying element 30 is supported and stabilised both vertically and horizontally, thereby preventing deflections and vibrations which might affect the measurement result obtained by the measuring equipment 1 as a result of these vibrations being transmitted to the object to be measured.

Figs. 4 and 5 show the measuring equipment 1 with the conveyor device 25 in the area of the measurement plane 10. In this embodiment, the I beams 28 in the area of the measurement plane 10, and hence the guideway 26 formed by the carrying run 40, are designed to bend inwardly towards one another and towards the conveying element 30. As a

result, a width 54 formed by outside edges 53 of the I beams 28 for most of their length is reduced to a width 55 in the area of the measurement plane 10, thereby preventing a shadow from falling on the measuring beams 17, in particular the boundary beams 20, in the offset area 56. This produces the cross-sectional measurement area 21 formed by the boundary beams 20 for the maximum dimensions 2,3 to be measured on the object 4 supported on the carriers 34. The length 57 of the carrier guide plate 33, at right angles to the direction of travel, is also greater than the width 54 of the conveyor device 25 outside the offset area 56, which provides a secure support for the carrier 34.

The offset of the I beams 28 in the area of the measurement plane 10 can be produced by bending methods in the case of new systems; however, in the case of existing systems which are to be fitted out with the measuring equipment 1, for example, it is likewise possible to weld prefabricated inserts into an existing system to form the offset part of the guideways.

Figs. 6 to 8 illustrate a further embodiment of the measuring equipment 1 where, in the direction of travel (the arrow 58), the measurement plane 10 formed by the emitter and receiver assemblies 8,9 is followed by another measurement plane 59. The measurement plane 59 is formed from emitter and receiver assemblies 60,61 for the emission and receiving of measuring beams 62. The measuring beams

62 of the measurement plane 59 run parallel to the measuring beams 17 of the emitter and receiver assemblies 8,9. The continuous conveyor device 25 with the profile section 27 forming the guideways 26 and the conveying element 30 extend through the measurement planes 10,59. To ensure that the carriers 34, which hold the objects to be measured 4, are supported continuously, in the measurement planes 10,59 recesses 63,64 are positioned in the profile sections 27 forming the guideways 26 with the exception of remaining guideway parts 42.

In the direction of travel (the arrow 58), a recess 63 in the measurement plane 10 and a recess 64 in the measurement plane 59 are positioned alternately from the outside edge 53 and an inside edge 65 of the profile section 27, which recesses extend parallel to but offset from each other and overlap by a distance 66 at right angles to the direction of travel (the arrow 58). The measuring beams 17,62 form the cross-sectional measurement area 67 in the measurement plane 59 and a cross-sectional measurement area 68 in the measurement plane 59 which cover the whole of the measuring area and a maximum dimension of the object 4 and are combined to give an overall result by collecting the individual measurement results in the control and evaluation unit 19. This arrangement therefore makes it possible to provide a continuous support for the guide plate 33 of the carrier 34 in the measurement planes

10,59. Furthermore, positioning the recesses 63,64 diametrically opposite each other in the direction of travel (the arrow 58) produces an unrestricted cross-sectional measurement area, which means that it is possible to take measurements without obstruction between a minimum dimension 69 and a maximum dimension 70 of the object 4.

Fig. 9 illustrates another embodiment of the measuring equipment 1 with the conveyor device 25 in the area of the measurement planes 10,59 formed by the measuring equipment 1 in the direction of travel (the arrow 58). In this case, in an interrupt area 71 facing measurement planes 10,59, the I beams 28 forming the guideways 26 are connected to an S-shaped connecting element 74 positioned between the ends 72,73 of the I beams 28 in the interrupt area 71. The S-shaped joining element 74 forms open areas 78,79 for the measuring beams 17,62, which areas alternately face the outside edge 53 and the inside edge 65 of side pieces 75,76,77 of the S-shaped joining element 74 in the measurement planes 10,59 in the direction of travel (the arrow 58). The open areas 78,79 overlap by a distance 66 at right angles to the direction of travel (the arrow 58) so that, with this embodiment too, different cross-sectional measurement areas in relation to the object to be measured 4 are defined by the measuring beams of the measuring equipment 1 in the measurement planes 10,59. The signals resulting therefrom are processed into measurement

data in the control and evaluation unit 19 or condensed to an overall cross-sectional measurement area from the individual cross-sectional measurement areas of the measurement planes 10,59.

Fig. 10 illustrates another embodiment of the measuring equipment 1 with the conveyor device 25. In the area of the measurement plane 10 the profile sections 27 have the interrupt area 71 with a gap of width 80 between their opposed ends 72,73 while the conveying element 30 passes through the measurement plane 10 without interruption. The carriers 34 for the object 4 to be measured are movably connected to the conveying element 30 and are slideably supported on the guideways 26. One guideway part 81, which is co-movable with the carrier 34 in the direction of travel (the arrow 58), faces one end 72 of the profile section 27 while projecting towards the other end 73 and is supported and able to move lengthwise on the profile section 27 in a guide arrangement 82 formed by guide bars 83 and linear guide elements 84.

Between one edge 85 of the guideway part 81 and the end 73 of the profile section 27 there is a gap 86 when the guideway part 81 abuts the front end 72, whereby the measuring beams 17 pass through the measurement plane 10 without obstructions or shadows. If, while moving in the direction of travel (the arrow 58), the carrier 34 reaches a support surface 39 of the guideway part 81, which surface

is positioned at the same level as the guideway 26, this support is passed through the guide arrangement 82 to support the carrier 34, co-moved until it abuts the opposite end 73 of the profile section 27 and, during this movement, forms a support for the carrier 34.

If, as a result of moving in the direction of travel (the arrow 58) and after travelling across the width 80, the carrier reaches its support position on the guideway 26 of the profile section 27 following in the direction of travel (the arrow 58), the guideway part 81 is moved back to abut the end 72 of the profile section 27, contrary to the direction of travel (the arrow 58). This restores the gap 86 and hence enables the measuring beams 17 to pass through without obstruction apart from a brief interruption while the carrier 34 or the guideway part 81 passes through the measurement plane 10. Movement of the guideway part 81 in or contrary to the direction of travel (the arrow 58) may be achieved by pressurised thrusters 87, as illustrated by way of example, or electric spindle drives may be used, for example.

The guideway part 81 which supports the carrier 34 as it transfers from one guideway 26 to the guideway 26 formed by the other profile section 27 in the interrupt area 71 produces a shock-free and vibration-free transfer, thereby avoiding inaccuracies when measuring the object 4.

Figs. 11 and 12 illustrate another embodiment of the

measuring equipment 1 with a measurement plane 88 positioned diagonally to the direction of travel (the arrow 58). In this embodiment the measurement plane 88 is formed by the beam emitter 11 and beam receiver 12 positioned in parallel horizontal planes on each side of the object 4 to be measured or the conveyor device 25. If there is only one emitter and receiver arrangement 8, only one dimension 91 of the object 4 can be established by determining the silhouette limits 89,90. Arranging the measurement plane 88 diagonally to the conveyor device 25 makes it possible to position recesses 92,93 which are offset in the direction of travel (the arrow 58) in chords 94,95 of the profile sections 27 forming the guideways 26. The recesses 92,93 have a depth 96 corresponding to the width 97 of the guideway 26 less the thickness 98 of a web 99 of the profile section 27. Positioned on the inside edge 65 of the chord 94 forming the guideway 26 are guideway parts 42 projecting towards the conveying element 30 and forming the support surface 39 for the guide plate 33. As a result of the offset arrangement of the recesses 92,93 and the guideway parts 42 forming the support surface 39 together with a support surface 100 formed by the web 99, in the measurement plane 88 the guide plate 33 is able to slide shock-free on the guideways 26 in the area of the recesses 92,93, thereby avoiding errors in the measurement result.

With this embodiment too, it is naturally possible to

retrofit an existing conveyor device 25 with the measuring equipment 1 at a particularly reasonable cost. Distributing the support surfaces 39 over the webs 99 and the stirrup-shaped guideway parts 42 ensures that an effective support is provided for the guide plate 33 of the carrier 34. However, this also makes it possible to keep the support surface 39, and hence the areas of shadow, small, which means that it is highly unlikely that the measurement result will be affected by the areas of shadow overlapping with the edges of the silhouette 89,90 of the object 4 to be measured.

Fig. 13 shows the measuring equipment 1 comprising an optoelectronic measuring device 101, for example an electronic scanning camera, with the conveyor device 25 for the object 4 to be measured. The optoelectronic measuring device 101 consists of silhouette recording equipment 102 and a source of radiation 103, for example a fluorescent lamp. Positioned in a row or line on a measuring surface 104 of the silhouette recording equipment 102 are radiation-sensitive elements 105. The radiation-sensitive elements 105 are used to determine the silhouette limits 89,90 formed by the object 4, and hence a dimension, for example a diameter 106, is determined in the control and evaluation unit 19. In the I beam 28 of the conveyor device 25, which beam forms the guideways 26, in the area of a measurement cross-section 107 of the optoelectronic

measuring device 101 the recesses 37 or the guideway parts 42 remaining in the region of the recesses 37 and forming the support surfaces 39 for the guide plate 33 of the carrier 34 are positioned in an area in which an area of shadow 108 caused by the guideway parts 42 is inside a minimum dimension 109 of the object 4.

In addition to the embodiment illustrated, another measuring device can, of course, be positioned so that its optical axis runs approximately at an angle of 90° to an optical axis 110 formed by the optoelectronic measuring device 101, as a result of which two diameter measurements of the object to be measured 4 can be taken approximately at right angles to each other in one pass. This makes it possible to calculate a mean value in the control and evaluation unit 19 if the outline of the object 4 is other than circular and hence to produce a result better than that obtained when using only one optoelectronic measuring device 101.

The design and positioning of the beam emitters and beam receivers and the evaluation of the measurements obtained therewith may accord with, for example, Austrian patent 351 282 or unexamined German applications DE-A 29 20 804, DE-A 32 38 883 and DE-A 34 14 819.

Within the framework of the invention it is, of course, possible to alter the positioning of the individual parts at will above and beyond the examples of embodiment

illustrated and to combine the parts in different ways. Individual features from the examples of embodiment illustrated may constitute independent solutions according to the invention.

In conclusion, it should be noted that individual parts of the drawings of the example of embodiment have been enlarged out of proportion and are shown in simplified diagrammatic form to aid understanding of the invention.

CLAIMS

1. Apparatus for measuring elongate objects passing along a conveyor system including a substantially horizontal guideway having one or more support surfaces for carriers supporting the objects to be measured, said apparatus comprising at least one measuring assembly with an emitter and receiver positioned on opposite sides of the conveyor to transmit and receive beams of radiation in a measuring plane extending across the path of said objects on the conveyor, wherein said guideway has at least one section, with a support surface thereon, which, if extended past said emitter and receiver, would intersect the paths of at least some of the beams passing therebetween, and wherein in the region of said measurement plane said guideway section is replaced by a section which is offset relative thereto and/or of smaller cross-section dimension, or by a support movable longitudinally across a gap in the guideway section, so as to interrupt fewer of said beams.

2. Measuring apparatus according to Claim 1, wherein the said guideway part in the measurement plane is positioned and dimensioned so as to allow beams passing on both sides of it to encounter the smallest object to be measured, or so as to lie outside the beam width needed to measure the largest such object.

3. Measuring apparatus according to Claim 1 or Claim 2,

wherein the guideway in the direction of travel is offset diagonally to the direction of travel in the plane of travel.

4. Measuring apparatus according to any preceding claim wherein one side of the guide surface in the region of the measurement plane is reduced to a part of the width in the section of the guideway adjacent to the measurement plane.

5. Measuring apparatus according to any preceding claim wherein the support surface of the guideway in the region of the measuring plane is offset towards the centre of the conveyor.

6. Measuring apparatus according to any preceding claim wherein at a short distance from the measurement plane (10) of the emitter and receiver assembly in the direction of travel there is another measurement plane formed by a second emitter and receiver assembly.

7. Measuring apparatus according to Claim 6 wherein the guideway part in the region of the measurement plane has two staggered recesses or offsets immediately following each other in the direction of travel and aligned with the two measuring planes.

8. Measuring apparatus according to any preceding claim further comprising a continuous conveying element linking the carriers for the object to be measured.

9. Measuring apparatus according to any preceding claim wherein at a short distance from the measurement plane and

positioned before and/or after it in the direction of travel of the objects to be measured are supports for the conveying element.

10. Measuring apparatus according to Claim 8 or Claim 9 wherein the conveying element continuously spans the area of the measurement plane.

11. Measuring apparatus according to any one of Claims 8 to 10, wherein a guide plate movably connected to the conveying element and forming part of the carriers for the objects to be measured is, perpendicular to the direction of travel, of a length equivalent to or greater than the maximum width of the horizontal guideway.

12. Measuring apparatus according to any preceding claim wherein measuring beams of one measurement plane which are interrupted by cross-sectional areas of a guideway part pass through another parallel measurement plane incongruently in the direction of travel.

13. Measuring equipment according to any preceding claim wherein an area of overlap in the measuring beams where parallel measurement planes are interrupted in the direction of travel, is positioned inside a minimum dimension of the object to be measured.

14. Measuring apparatus according to any preceding claim wherein the guideway part is movably supported in the longitudinal direction of the guideway and is fitted with a drive or a stop which interacts with the carrier and

wherein one adjustment path of the guideway part corresponds to at least one width between the spaced front ends of the guideway in the area of the measurement plane.

15. Measuring apparatus according to any preceding claim wherein, by means of a control device forming part of the measuring equipment, in the absence of one of the control signals defining one of the two edges of the silhouette of the object being measured, at least one emitter and receiver arrangement adjacent to the emitter and receiver arrangements of the measuring beams interrupted by guideway parts is simultaneously connected to one or more of the emitter and receiver arrangements facing the interrupted measuring beams.

16. Measuring apparatus according to Claim 14, wherein the receiver units immediately adjacent, on both sides of the receiver units for the interrupted measuring beams are consecutively actuated via the control and evaluation unit, consecutively in each case with half the beam receivers for the interrupted measuring beams and wherein an output signal from the relevant beam receivers is evaluated and/or stored in the control and evaluation unit.

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**Examiner's report to the Comptroller under Section 17 (The Search Report)** - 28 -

| Application number |
|---|
| GB 9213298.4 |

| Relevant Technical fields | Search Examiner |
|---|---|
| (i) UK Cl (Edition K) G1A (AEB AED AEF AEJ) | K SYLVAN |
| (ii) Int Cl (Edition 5) G01B | |
| **Databases** (see over) | Date of Search |
| (i) UK Patent Office | 18 AUGUST 1992 |
| (ii) | |

Documents considered relevant following a search in respect of claims 1-16

| Category (see over) | Identity of document and relevant passages | Relevant to claim(s) |
|---|---|---|
| | NONE | |

SF2(p)

HCS - doc99\fil000178

| Category | Identity of document and relevant passages | Rele ,t to claim(s) |
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